CLAIM LISTING

1. (Previously presented) A method of snapshot operation for a data storage system with a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN) containing source data and a target VLUN, preserving first snapshot data of the source data at an instant in time and second snapshot data of the source data at a later instant in time, wherein the first and second snapshots persist concurrently, comprising:

generating first metadata to locate the first snapshot data and to indicate when a data element of the first snapshot data is in the target VLUN; and

generating second metadata to locate the second snapshot data and to indicate when a data element of the second snapshot data is in the target VLUN, wherein the first and second metadata locate an original data element of the first snapshot data and of the second snapshot data at the same address of the target VLUN.

2. (Previously presented) The method of claim 1, wherein generating the first metadata includes generating a first log file pointer to locate the original data element in the target VLUN.

3. (Previously presented) The method of claim 2, wherein generating the first metadata includes changing a first bitmap to indicate the original data element has migrated to the target VLUN.

4. (Previously presented) The method of claim 1, wherein generating the second metadata includes generating a second log file pointer to locate the original data element in the target VLUN.

5. (Currently amended) The method of claim 4, wherein generating the second metadata includes changing a second bitmap to indicate the original data element has migrated to the target VLUN.

6. (Previously presented) A snapshot system for a data storage system including a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, and metadata, comprising:

a source VLUN for active data;

a target VLUN to store migrated snapshot data;

first metadata to indicate when and to locate where the first snapshot of the active data is in the target VLUN; and

second metadata to indicate when and to locate where second snapshot data of the active data is in the target VLUN wherein the first metadata and the second metadata indicate and locate a data element common to the first and second snapshot data in the target VLUN, wherein the snapshot system preserves the active data of the first snapshot while taking the second snapshot.

7. (Original) The snapshot system of claim 6, wherein the first metadata includes a first log file pointer to locate the first snapshot data in the target VLUN and the second metadata includes a second log file pointer to locate the second snapshot data in the target VLUN.

8. (Original) The snapshot system of claim 6, wherein the first metadata includes a first bitmap to indicate when the first snapshot data has migrated to the target VLUN and a first log file to locate the first snapshot data in the target VLUN, and the second metadata includes a second bitmap to indicate when the second snapshot data has migrated to the target VLUN and a second log file to locate the second snapshot data in the target VLUN.

9. (Previously presented) The snapshot system of claim 6, wherein a first bitmap and a second bitmap indicate that the first snapshot data and the second snapshot data have migrated to the target VLUN.

10. (Previously presented) The snapshot system of claim 6, wherein a first log file and a second log file locate the first snapshot data and the second snapshot data that have migrated to the target VLUN.

11. (Previously presented) The snapshot system of claim 6, wherein the first metadata and the second metadata indicate some of the first and second snapshot data remain in the source VLUN.

12. (Original) The snapshot system of claim 6, wherein the first metadata indicates that the original data of the first snapshot is in the target VLUN and the second metadata indicates that the original data of the second snapshot is in the source VLUN.

13. (Previously presented) The snapshot system of claim 6, wherein a first log file and a second log file each include a pointer identifying the address of the common data element in the target VLUN.

14. (Previously presented) A method of destaging data of one or more snapshots to maintain data consistency of original data between a cache memory and a target Virtual Logical Unit Number (VLUN) of a data storage system, comprising:

reading bitmaps for all of the snapshots into a first host memory;

reading log files for all of the snapshots into the first host memory;

searching the bitmaps to identify snapshots that require the original data to be destaged;

destaging the original data to an available location in the target VLUN;

updating each log file associated with the identified bitmaps by adding pointers to the original data located in the target VLUN; and

updating each associated bitmap to indicate completion of the destage operation to the target VLUN.

15. (Original) The method of claim 14, further comprising searching the bitmaps for the presence of original data in the target VLUN, determining the next available target address for the next destage operation, checking the cache memory to see if other original dirty data needs to be destaged to the target VLUN and if so, identifying additional snapshots requiring original data to be destaged and if not, writing updated bitmaps and log files to the target VLUN.

16. (Previously presented) The method of claim 14, further comprising writing the log files and the bitmaps to the target VLUN, removing a dirty data designation for the destaged original data still in the cache memory and sending a destage operation complete status.

17. (Previously presented) A method of snapshot operation in a data storage system in a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, first metadata, and second metadata, comprising:

receiving requests from an application to modify data in the cache memory;

writing the modified data to the cache memory;

destaging the original data to the target VLUN to preserve the original data of a first snapshot and a second snapshot; and

updating the first and second metadata to locate the original data common to the first and second snapshot in the target VLUN.

18. (Original) The method of claim 17, further comprising destaging the first and second metadata to the target VLUN.

19. (Original) The method of claim 17, further comprising updating the first and second metadata to indicate the presence of the destaged original data in the target VLUN.

20. (Original) The method of claim 19, further comprising destaging the first and second metadata to the target VLUN.

21. (Original) The method of claim 17, further comprising destaging the modified data in the cache memory to the source VLUN to maintain data consistency.

22. (Currently amended) A method of snapshot operation in a data storage system in a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, a plurality of bitmaps, and a plurality of log files, comprising:

receiving requests from an application to modify data in the cache memory;

writing the modified data to the cache memory;

destaging ~~the~~ original data to the target VLUN to preserve the original data of a first snapshot and a second snapshot;

adding a pointer in a first log file to locate the original data in the target VLUN;

updating a first bitmap to indicate the presence of the destaged original data in the target VLUN;

adding a pointer to the original data in a second log file to locate the original data in the target VLUN; and

updating a second bitmap to indicate the presence of the original data in the target VLUN.

23. (Original) The method of claim 22, further comprising destaging the modified data in the cache memory to the source VLUN to maintain consistency.

24. (Original) The method of claim 22, further comprising destaging the first and second bitmaps and the first and second log files to the target VLUN.

25. (Currently amended) The method of claim 14, wherein the step of searching the bitmaps to identify snapshots that require the original data to be destaged occurs after the data storage system fails and includes reading a bitmap, wherein if the ~~bitmaps contain~~ bitmap contains a value in a bit position ~~identifying~~ indicating that the original data is dirty in cache memory, destaging the original data to the target VLUN, and wherein if the bitmap contains an inverse value in the bit position ~~representing~~ indicating the presence of the original data in the target VLUN, not destaging the original data.

26. (Previously presented) A method of snapshot operation for a data storage system with a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN) and a target VLUN, comprising:

generating first metadata to locate first snapshot data and to indicate when the first snapshot data is in the target VLUN, wherein generating the first metadata includes generating a first log file pointer to locate first snapshot data in the target VLUN; and

generating second metadata to locate second snapshot data and to indicate when the second snapshot data is in the target VLUN, wherein the first and second metadata locate the same data in the target VLUN, and wherein generating the first metadata includes changing a first bitmap to indicate first snapshot data has migrated to the target VLUN.

27. (Previously presented) A method of snapshot operation for a data storage system with a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN) and a target VLUN, comprising:

generating first metadata to locate first snapshot data and to indicate when the first snapshot data is in the target VLUN; and

generating second metadata to locate second snapshot data and to indicate when the second snapshot data is in the target VLUN, wherein the first and second metadata locate the same data in the target VLUN, wherein generating the second metadata includes generating a second log file pointer to locate second snapshot data

in the target VLUN, and wherein generating the second metadata includes changing a second bitmap to indicate second snapshot data has migrated to the target VLUN.

28. (Currently amended) A snapshot system for a data storage system including a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, and metadata, comprising:

a source VLUN for active data;

a target VLUN to store migrated snapshot data;

first metadata to indicate when and to locate where ~~the~~ first snapshot data is in the target VLUN, wherein the first metadata includes a first bitmap to indicate when the first snapshot data has migrated to the target VLUN and a first log file to locate the first snapshot data in the target VLUN; and

second metadata to indicate when and to locate where second snapshot data is in the target VLUN, wherein the first metadata and the second metadata ~~to~~ indicate and locate the same snapshot data in the target VLUN, and wherein the second metadata includes a second bitmap to indicate when the second snapshot data has migrated to the target VLUN and a second log file to locate the second snapshot data in the target VLUN.

29. (Currently amended) A snapshot system for a data storage system including a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, and metadata, comprising:

a source VLUN for active data;

a target VLUN to store migrated snapshot data;

first metadata to indicate when and to locate where ~~the~~ first snapshot data is in the target VLUN; and

second metadata to indicate when and to locate where second snapshot data is in the target VLUN, wherein the first metadata and the second metadata ~~to~~ indicate and locate the same snapshot data in the target VLUN, wherein the first metadata and the second metadata indicate snapshot data ~~remain~~ in the source VLUN.

30. (Currently amended) A method of snapshot operation in a data storage system in a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, first metadata, and second metadata, comprising:

receiving requests from an application to modify data in the cache memory;

writing the modified data to the cache memory;

destaging ~~the~~ original data to the target VLUN to preserve the original data of a first snapshot and a second snapshot;

updating the first and second metadata to locate the original data in the target VLUN; and

destaging the first and second metadata to the target VLUN.

31. (Previously presented) A method of snapshot operation in a data storage system in a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, first metadata, and second metadata, comprising:

receiving requests from an application to modify data in the cache memory;

writing the modified data to the cache memory;

destaging the original data to the target VLUN to preserve the original data of a first snapshot and a second snapshot;

updating the first and second metadata to locate the original data in the target VLUN;

updating the first and second metadata to indicate the presence of the destaged original data in the target VLUN; and

destaging the first and second metadata to the target VLUN.

32. (Previously presented) A method of snapshot operation in a data storage system in a first host that communicates with a cache memory, a source Virtual Logical Unit Number (VLUN), a target VLUN, first metadata, and second metadata, comprising:

receiving requests from an application to modify data in the cache memory;

writing the modified data to the cache memory;

destaging the original data to the target VLUN to preserve the original data of a first snapshot and a second snapshot;

updating the first and second metadata to locate the original data in the target VLUN; and

destaging the modified data in the cache memory to the source VLUN to maintain data consistency.